

## **REMARKS**

Claims 1-7 are presently pending in this application.

Applicants' representatives wish to thank the Examiner for the courtesy of a telephonic interview on March 10, 2005. During the interview, the rejections of record were discussed. No final agreement was reached.

### *The Invention*

An etching solution of the present invention comprises hydrofluoric acid, nitric acid, and hexafluorosilicic acid, the concentration of the hexafluorosilicic acid being 10% to 40% by weight based on the weight of the etching solution.

### *The Rejection of the Claims*

Claims 1-7 have been rejected as unpatentable over Lee (US 6,284,712) in view of Uchida (US 5,307,296). Applicants traverse this rejection.

The teachings of the Lee and Uchida references have been previously described. It is Applicants' position that neither the Lee reference nor the Uchida reference, alone or in combination, render the claimed invention obvious.

In the Advisory Action dated January 14, 2005 ("the Advisory Action"), the Examiner appears to concede that neither the Lee reference nor the Uchida reference provide a teaching of the claimed solutions. However, the Examiner stated that "applicants have failed to provide evidence, which shows the concentration of the hexafluorosilicic acid being 10% to 40% based on the weight of

the etching solution . . . is critical". Moreover, in the Advisory Action, the Examiner stated that

since Lee . . . discloses the same combination of components of an etching solution . . . it would have been obvious [to the skilled artisan]. . . to have been motivated to select any amount in terms of weight percent of the disclosed components including hexafluorosilicic acid for the purpose of etching a silicon wafer.

These statements are traversed.

First, as previously described, the Lee reference does not teach that addition of  $\text{H}_2\text{SiF}_6$  to a mixed acid etchant solution is sufficient to provide adequate control over the etching process. On the contrary, the Lee reference (as cited in Applicants' previous communication) states that "the chemical activities which occurs during etching is still difficult to control, and as a result, they impart considerable etching damage on silicon wafers," even with the addition of a saturating concentration hexafluorosilicic acid to the conventional etching solution. In this respect, at least, the Lee reference teaches away from the use of hexafluorosilicic acid in mixed acid etching solutions. Other portions of the Lee reference mention hexafluorosilicic acid as a "toxic  $\text{H}_2\text{SiF}_6$  reaction product" (see, e.g., col. 10, lines 23 – 26), which the etching solution of Lee seeks to avoid. Thus, the Lee reference does not contain the requisite teaching or suggestion of the claimed solutions to motivate one of ordinary skill in the art to arrive at the claimed invention.

Second, Applicants respectfully disagree with the Examiner's statement, in the Advisory Action, that the present specification provides evidence of non-criticality of the amount of hexafluorosilicic acid. The Examiner states that "[at] page 10, lines 19-20, applicants disclose 'the upper limit of the concentration of hexafluorosilicic acid is not particularly restricted.'" Applicants submit that this

statement must be read in the context of the discussion of the hexafluorosilicic acid concentration in the specification. The specification teaches that, while a variety of concentrations can be effective to etch a substrate, certain concentrations are optimal. For example, *the very next sentences* (after that cited by the Examiner) state as follows:

However, when the concentration of the hexafluorosilicic acid is too high, the etching speed is lowered so that the time for picking-up the wafer tends to be undesirably prolonged. Therefore, the concentration of the hexafluorosilicic acid contained in the etching solution is preferably not more than 40% by weight . . .

Specification at lines 20-26.

Applicants therefore contend that the present specification teaches that the concentration of hexafluorosilicic acid is indeed important to the proper functioning of the claimed etchant solutions.

Third, Applicants have discovered that etching solutions containing concentrations of hexafluorosilicic acid greater than 40% are not optimally suited to etching silicon wafers. In support of this statement, Applicants submit the Declaration of Katsuji Itou Under 37 C.F.R. 1.132 (attached hereto as Appendix A). As described by Mr. Itou in the Declaration, an experiment was carried out in which an acid etching solution was prepared having a concentration of hexafluorosilicic acid of 42.7% by weight (see Declaration at paragraph 5), outside the claimed range of 10% to 40% as required by the pending claims. When this solution was used to etch a silicon substrate, by the method described in the present specification, it was found to exhibit relatively poor etching stability (see Declaration at paragraph 5 and Tables 1 and 2, in which this solution was graded as being in the range from “slightly unstable, and etching speed tended to be too rapid according to kind of wafer etched” to “unstable”). In contrast, solutions containing concentrations of

hexafluorosilicic acid below 40% (see, e.g., Examples 1-13 of the present specification, and particularly Examples 8-10) were found to be better suited to etching a silicon substrate (the solutions of Examples 1-13, each having less than 40% hexafluorosilicic acid by weight, all have superior grades compared to the solution of the Declaration, which has greater than 40% hexafluorosilicic acid by weight).

Applicants submit that the etching solutions of the claims patentably distinguish the cited references. Applicants reiterate their view that the cited art does not teach that the concentration of hexafluorosilicic acid in an etching solution is a result-effective variable; thus, the cited references neither teach nor suggest the claimed invention. There is simply no motivation to modify the teachings of the cited references to arrive at the claimed invention. Applicants respectfully contend that the cited references, whether alone or in combination, do not render obvious the claimed invention.

For at least the above reasons, reconsideration and withdrawal of this rejection is proper and the same is requested.

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**CONCLUSION**

It is respectfully submitted that the present application is in condition for allowance. An early consideration and notice of allowance are earnestly solicited.

In the event that an extension of time is required for this response to be considered timely submitted, the undersigned hereby conditionally petitions for any extension of time necessary. It is not believed any additional fees are required; however, if an additional fee is required, or if an overpayment is made, please charge/credit our deposit account 04-1105.

Respectfully submitted,

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